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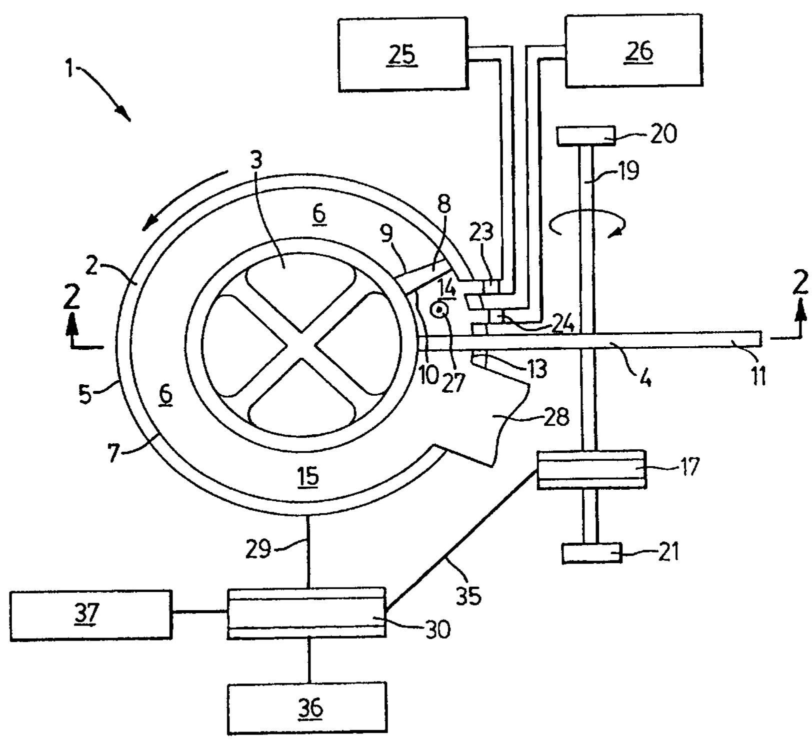
(54) Title: INTERNAL COMBUSTION ENGINE

(57) Abstract

An internal combustion engine that has an engine block (2) with an engine cylinder having a circular and generally toroidal shaped bore with a relatively constant cross–sectional area. A rotor (7) is rotationally positioned within the engine block (2) and is concentric with the engine cylinder. The rotor (7) has at least one outwardly extending radial vane (8) with a leading (9) and a trailing (10) edge. The vane (8) is received within the engine cylinder bore and dimensioned so as to closely fit within the internal cross–sectional area of the bore so that upon rotation of the rotor (3) the walls of the engine cylinder bore are swept by the vane (8). The engine further includes at least one reaction wheel (11) that is engageable and disengageable with the engine cylinder. When engaged with the engine cylinder the reaction wheel (11) spans the internal cross–sectional area of the cylinder bore such that the portion of the cylinder bore between the reaction wheel and the trailing edge (10) of the vane member (8) defines a combustion chamber. The portion of the cylinder bore between the reaction wheel (11) and the leading edge (9) of the vane member (8) defines an exhaust chamber. When the reaction wheel (11) is disengaged from the engine cylinder the vane (8) is free to sweep past the reaction wheel (11) within the cylinder bore.



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TITLE: Internal Combustion Engine

FIELD OF THE INVENTION

This invention relates generally to internal combustion engines of the type that ignite or burn a fuel and oxygen mixture within a confined compartment or cylinder in order to rotate a drive shaft to perform a desired task. In particular, the invention relates to a rotary internal combustion engine of the type having a circular, generally toroidal shaped, cylinder and a rotor positioned concentrically therein.

BACKGROUND OF THE INVENTION

Internal combustion inventions have been used for decades for a wide variety of applications. Currently the widest and most extensive use of internal combustion engines is in the automotive industry, however, similar engines of varying sizes and complexities have been used across the entire transportation industry, for the generation of electricity, to pump water, to operate a wide variety of different power tools, and for countless other applications.

The two most common forms of internal combustion engines that have been developed are the reciprocating and the rotary engine. Reciprocating engines have been by far the most widely commercialized and accepted form of internal combustion engine, however rotary engines generally offer a number of significant advantages over reciprocating versions. For example, the reversal in the direction of movement of the piston in a reciprocating engine results in a loss of energy and may cause balancing and vibrational problems, particularly where a number of pistons and cylinders are utilized. In addition, the length of the power stroke in a reciprocating engine has substantial and practical limitations which in many cases limits efficiency by not allowing for complete burning of fuel and air mixtures.

Incomplete burning during a power stroke can cause an excessive emission of particulate and unburned gaseous exhaust.

The advantages presented by rotary internal combustion engines over those of a reciprocating variety stem primarily from the fact that motion of the rotor is circular and continuous. Unlike reciprocating engines there is no reversal in direction of the rotor between the power and exhaust strokes. In this manner vibration is minimized and the losses associated with reversing piston direction engine are eliminated. In addition, rotary engines are usually considerably lighter in mass than internal combustion engines having the same power output. Nevertheless, rotary engines have also suffered from their own shortcomings, including relatively high fuel usage, and in some cases complex internal structures that add to expense and present potential maintenance problems.

SUMMARY OF THE INVENTION

The invention therefore provides a rotary internal combustion engine that addresses many of the limitations of a reciprocating internal combustion engine and that is also mechanically simpler and more fuel efficient than many previously developed rotary engines.

Accordingly, in one of its aspects the invention provides an internal combustion engine comprising an engine block having an engine cylinder with a circular and generally toroidal shaped bore with a relatively constant cross-sectional area, a rotor rotationally positioned within said engine block and concentric with said engine cylinder, said rotor having at least one outwardly extending radial vane member having a leading and a trailing edge, said vane member received within said engine cylinder bore and dimensioned so as to closely fit within the internal cross-sectional area of said bore so that upon rotation of said rotor the walls of said engine cylinder bore are swept by said vane member, and, at least one cylinder bore blocking means

engageable and disengageable with said engine cylinder, when said cylinder bore blocking means is engaged with said engine cylinder said cylinder bore blocking means spanning the internal cross-sectional area of said cylinder bore such that the portion of said cylinder bore between said cylinder bore blocking means and said trailing edge of said vane member defines a combustion chamber and the portion of said cylinder bore between said cylinder bore blocking means and said leading edge of said vane member defines an exhaust chamber, when said cylinder bore blocking means is disengaged from said engine cylinder said cylinder bore blocking means allowing for said vane member of said rotor to sweep past said cylinder bore blocking means within said cylinder bore.

Further objects and advantages of the invention will become apparent from the following description taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings which show the preferred embodiments of the present invention in which:

Figure 1 is a plan sectional view of the internal combustion engine according to the present invention;

Figure 2 is a sectional view taken along the line 2-2 of Figure 1;

Figure 3 is a side view of the reaction wheel shown in Figures 1 and 2;

Figure 4 is a longitudinal side view of the reaction wheel from direction 4 as shown in Figure 3;

Figure 5 is a plan sectional view of an alternate embodiment of the invention shown in Figure 1 having multiple engine blocks and multiple rotors;

Figure 6 is a further embodiment of the present invention depicting a single rotor engine having a pair of vanes and reaction wheels; and,

Figure 7 is a side view of one of the reaction wheels of Figure 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention may be embodied in a number of different forms. However, the specification and drawings that follow describe and disclose only some of the specific forms of the invention and are not intended to limit the scope of the invention as defined in the claims that follow herein.

The internal combustion of the present invention is indicated generally in the attached drawings by reference numeral 1. Internal combustion engine 1 is a rotary engine and is generally comprised of an engine block 2, a rotor 3 and at least one cylinder bore blocking means 4. For purposes of illustration, the enclosed figures are schematic in nature and identify the primary functional parts of internal combustion engine 1 and their operation. It will be appreciated by those skilled in the art that modern day internal combustion engines include a very wide variety of complex fuel delivery, emission control, electronic control, and other systems. Even though such devices are not specifically shown in the attached drawings, it will also be appreciated that they may be utilized in conjunction with the overall structure of the internal combustion engine as shown and described.

Referring specifically to Figures 1 and 2, engine block 2 is generally comprised of an outer housing 5 that retains an engine cylinder 6. Engine cylinder 6 is generally circular in nature and has a generally toroidal shaped cylinder bore 7 having a

relatively constant cross-sectional area. The internal surface of engine bore 7 is preferably polished and formed from a hardened metallic substance. In most cases it is expected that the walls of engine cylinder 6 will be comprised of a separate material from block 2. The cylinder walls may be machined using precision equipment whereas engine block 2 may be comprised of a less expensive cast or similar material. While in the attached drawings engine block 2 is shown as being circular in nature it will be appreciated that it may equally be formed in a variety of other geometric shapes.

Rotor 3 is rotationally positioned within engine block 2 such that it is concentric with engine cylinder 6. Rotor 3 includes at least one outwardly extending radial vane member 8 that is received within cylinder bore 7 and dimensioned so that it closely fits within the internal cross-sectional area of bore 7. In the preferred embodiment vane member 8 would be machined from the same or a similar material as cylinder 6 and would also be precision made with very close tolerances imposed upon its overall dimension. Forming vane member 8 from the same or a similar material as engine cylinder 6 will ensure that the co-efficient of thermal expansion of the two parts is such that upon heating of the engine the degree of tolerance between vane member 8 and cylinder bore 7 will remain approximately constant. In addition, manufacturing or machining vane member 8 within precise size limits will ensure a close fit of the vane within the cross-sectional area of bore 7. In order for efficient operation of internal combustion engine 1 vane member 8 must effectively seal against the internal surfaces of bore 7 so as to prevent or limit the passage of gases between the two parts. Dimensioning vane member 8 such that it closely fits within the cross-sectional area of bore 7 allows the vane member to effectively sweep the walls of the cylinder bore upon rotation of rotor 3. It will also be appreciated that vane member 8 may be formed from a single piece of material or may be formed from a central body upon which a precision made, high strength, exterior housing may be attached.

Referring specifically to Figures 1 and 2, cylinder bore blocking means 4 of internal combustion engine 1 is structured so as to be engageable and disengageable with engine cylinder 6. While the cylinder bore blocking means may take a variety of different forms, including plates, side gates and similar structures, in the preferred embodiment it comprises at least one reaction wheel 11 situated generally external to engine block 2 such that the reaction wheel rotationally engages and disengages engine cylinder 6. As shown more specifically in Figures 2 and 3, preferably reaction wheel 11 is a relatively thin member, that rotates about an axis perpendicular to the axis of rotation of rotor 3, and that has one edge received through the exterior housing 5 of engine block 2 in such a manner that when reaction wheel 11 is "engaged" with engine cylinder 6 it effectively spans the internal cross-sectional area of cylinder bore 7. Since the axis of rotation of reaction wheel 11 is generally perpendicular to the axis or rotation of rotor 3, when in its "engaged" position reaction wheel 11 will therefore span the internal cross-sectional area of cylinder bore 7 in a manner that is generally parallel to the axis of rotation of rotor 3. Accordingly, when "engaged" with the engine cylinder reaction wheel 11 effectively bifurcates cylinder bore 7 and limits the transmission of gases around the cylinder bore. That is, in this position reaction wheel 11 effectively creates a partition or blockage within the cylinder bore. To that end, in the preferred embodiment reaction wheel 11 is also a precision made component that closely fits through a slot 13 within exterior housing 5 of engine block 2. A variety of different sealing mechanisms may also be employed at the point of contact between the engine block and the engine cylinder and reaction wheel 11. Such sealing mechanisms are commonly employed within internal combustion engines in order to prevent the escape of gases and to retain engine oil and other lubricants.

It will therefore be appreciated that when reaction wheel 11 is engaged with engine cylinder 6 it will serve to effectively create a compartment within cylinder bore 7 defined by one side of the reaction wheel, the walls of the cylinder bore, and the trailing edge 10 of vane member 8 (see Figure 1). Similarly, a further compartment

within cylinder bore 7 will be defined by the leading edge 9 of vane member 8, the walls of the cylinder bore, and the opposite side of reaction wheel 11. The compartment or portion of cylinder bore 7 defined generally by trailing edge 10 of vane member 8 and the surface of reaction wheel 11 defines a combustion chamber 14, whereas the compartment or that portion of cylinder bore 7 defined generally by leading edge 9 of vane member 8 and the opposite side of reaction wheel 11 defines an exhaust chamber 15. In this manner when reaction wheel 11 engages engine cylinder 6, it effectively limits the exchange of gases between combustion chamber 14 and exhaust chamber 15.

So as to enable rotor 3 to freely revolve within cylinder bore 7 and without interacting with reaction wheel 11, reaction wheel 11 preferably includes at least one slot 16 that selectively engages and disengages cylinder bore 7. When slot 16 is engaged with the cylinder bore it is effectively aligned with the cross-sectional area of the bore and thereby permits vane member 8 to freely sweep past reaction wheel 11 as it rotates through the cylinder. Rotation of reaction wheel 11 from a position where slot 16 is aligned with the cross-sectional area of cylinder bore 7 will result in the disengagement of slot 16 from the cylinder bore. Once slot 16 has been fully disengaged reaction wheel 11 will again span the internal cross-sectional area of cylinder bore 7. In this manner it will be appreciated that through rotation of reaction wheel 11 combustion and exhaust chambers 14 and 15 may be created within cylinder bore 7 while at the same time allowing for the free rotation of rotor 3 and the revolution of vane member 8 within cylinder bore 7.

In the preferred embodiment a timing means 17 is utilized to ensure that reaction wheel 11 and rotor 3 move in a synchronous fashion so that vane member 8 is able to freely sweep past reaction wheel 11 upon each revolution of rotor 3. That is, through synchronizing the rotation of reaction wheel 11 with the rotation of rotor 3, slot 16 can be precisely aligned with the cross-sectional area of cylinder bore 7 as vane member 8 approaches the reaction wheel to thereby allow it to freely sweep

past. Since the rotation of reaction wheel 11 is constant in nature, the internal edges 18 of slot 16 preferably taper across their width, as shown more specifically in Figure 4. As reaction wheel 11 rotates slanted edges 18 of slot 16 will allow the slot to remain aligned with the internal cross-sectional area of cylinder bore 7 for a sufficient length of time to enable vane member 8 to fully sweep by the reaction wheel. It will be appreciated by those skilled in the art that rather than, or in addition to, utilizing slanted edges 18 the size of slot 16 may be made sufficiently large so as to enable vane member 8 to fully sweep by the reaction wheel without interference. In general, the size of slot 16 will also have to be sufficiently large to incorporate an acceptable safety factor and reduce the potential for the vane to strike the wheel during rotation.

The synchronous movement of reaction wheel 11 and rotor 3 may be accomplished mechanically in which case timing means 17 is a series of precision gears and/or shafts (indicated generally by line 35 in the attached Figures). Synchronous movement may also be accomplished through a direct drive mechanism, such as electric or hydraulic drives, attached to reaction wheel 11. Preferably reaction wheel 11 is driven by a shaft 19 supported at each end by bearings 20 and 21. Where reaction wheel 11 is driven mechanically through precision gears and shafts attached to rotor 3, a gear box may be connected directly to shaft 19. Otherwise, precision direct drive mechanisms may be connected directly to shaft 19.

With reference to the above structure, the operation of internal combustion engine 1 will now be described in more detail. In Figure 1 the assumed rotation of vane member 8 is counterclockwise. Engine cylinder 6 preferably includes a fuel input means which includes a fuel input valve 23. In the embodiment shown in Figure 1 a compressed fuel and air mixture is supplied to valve 23 by a fuel injector 25. Fuel injector 25 may include a compressor as well as an air input means. Fresh air is separately supplied to an air input valve 24 by way of an air filtration device 26 so as to prevent the formation of a vacuum behind vane member 8 as it rotates.

Through use of currently available fuel and air delivery devices, when vane member 8 is positioned such that it has rotated past reaction wheel 11 with the reaction wheel in its engaged position such that it spans and blocks the cross-sectional area of cylinder bore 7, fuel input valve 23 opens momentarily and a compressed fuel and air mixture is injected into combustion chamber 14. Once a pre-determined amount of fuel has been injected, fuel input valve 23 closes and a spark plug 27 fires to ignite the fuel mixture causing the expanding combustion gases to propel vane member 8 rotationally around cylinder bore 7. An exhaust port 28, situated on the opposite side of reaction wheel 11 to fuel input valve 23 and air input valve 24, enables air and gases in exhaust chamber 15 to be swept out of cylinder bore 7. As vane member 8 continues to rotate around cylinder bore 7, it approaches exhaust port 28. When the vane proceeds past the edge of the exhaust port the combustion gases behind trailing edge 10 of vane member 8 escape through the exhaust port and pressure in the combustion chamber drops. As vane member 8 proceeds closer to reaction wheel 11, the synchronous drive of the reaction wheel causes the leading edge of slot 16 to begin to intersect cylinder bore 7. By the time that vane member 8 has rotationally reached the point of intersection with reaction wheel 11, slot 16 is fully aligned with engine bore 7 so that the vane may pass therethrough. At this point the power stroke is completed and the vane proceeds to sweep past reaction wheel 11. By the time that vane member 8 has passed a few degrees beyond reaction wheel 11, the reaction wheel will have rotated to a sufficient degree such that it once again spans and blocks the internal cross-sectional area of cylinder bore 7. Vane member 8 will then continue to rotate through cylinder bore 7 past air input valve 24. Once vane member 8 has swept past air input valve 24 filtered air is preferably drawn into combustion chamber 14 behind trailing edge 10 of the vane to prevent the formation of a vacuum. As the vane continues on its circular path through cylinder bore 7, air input valve 24 closes and the vane once again sweeps past fuel input valve 23 that again injects a compressed fuel and air mixture into the combustion chamber. At that point the power stroke repeats itself. Spark plug 27 fires to ignite the air/fuel mixture to once again drive vane member 8 rotationally around cylinder bore 7.

Preferably the reaction wheel and the rotor are balanced to reduce stress and vibration. In the single rotor vane embodiment shown in Figures 1 and 2, balancing of the rotor may require the addition of balancing weights 39.

It will be appreciated that the above description provides an explanation as to the general and overall operation of the present invention but that there will be in addition a variety of supplementary systems and aspects of a standard internal combustion engine that will be utilized during operation. For example, there will be electrical, cooling, ignition and starting systems necessary for the operation of the present invention. Those systems will be generally similar to ones currently used with necessary adaptations. In addition, in the preferred embodiment fuel input valve 23, air input valve 24 and spark plug 27 are of conventional design.

Lubrication of vane member 8 within cylinder bore 7 may be achieved through separately adding an appropriate amount of lubricant or oil to the fuel mixture, or alternately through mixing lubricating oil with the fuel/air mixture and injecting both through valve 23. Reaction wheel 11 may be lubricated through spraying or wiping a thin film of oil over its surface so as to provide a sufficient degree of lubrication while preventing excessive oil from entering the combustion chamber. As in conventional internal combustion engines, the oil within the engine compartment may be circulated by way of an oil pump through a filtering mechanism to remove particulate contaminants. Various bearings and gears utilized throughout internal combustion engine 1 are lubricated by conventional means.

In the preferred embodiment the interface between rotors 3 and the interior of engine block 2 is lubricated by pressurized engine oil fed through oil ports in the engine block (not shown). The interface gap preferably increases slightly in the direction of the central axis of rotor 3 so as to cause excess oil to flow out from in the interface and into the central portion of the rotor. Rotor 3 may include a number of spokes or oil channels that allow excess oil to drain into an oil pan beneath the engine block

and below the rotor. Oil that is collected in the oil pan may be accumulated, pumped through a filter and recirculated back to engine block 2.

In order to allow internal combustion engine 1 to preform its desired task, rotor 3 is connected to a drive shaft or drive element 29 which may be used to drive a transmission or a wide variety of other devices. Drive shaft 29 will typically be supported by a pair of bearings 38 (see Figure 2). In Figure 1 line 29 generally represent a drive shaft, connected to rotor 3, that drives a transmission 30. Transmission 30 may in turn transfer power to a load 36 (for example the wheels of a vehicle, a pump impeller, the rotor in a generator, etc.) and may also independently drive ancillary parts and mechanisms 37 used during the operation of the engine (for example alternators, oil pumps, water pumps, etc.). As discussed previously, rotor 3 may also be utilized for purposes of the synchronized drive of reaction wheel 11.

Figure 5 shows an alternate embodiment of the present invention wherein four separate rotary engine blocks are utilized. In this instance all four rotors are interconnected so as to drive a single transmission 30. To minimize the size of the engine in the configuration shown in Figure 5 adjacent rotors share a common reaction wheel 11 having a single slot 16. The adjacent rotors are constructed so as to rotate in opposite directions as indicated by the arrows in Figure 5. Each rotor once again has a single vane member 8 such that each independent vane member sweeps through the slot on the single reaction wheel 180 degrees out of phase. The sequencing and firing and the power and exhaust strokes of each independent engine block and rotor will be the same as described above. In addition, each adjacent pair of engine blocks and rotors can be structured so as to fire out of phase in order to deliver a constant level of power to transmission 30. It will also be appreciated that with four independent engine blocks and rotors, a variety of different firing sequences are possible. Through altering the firing sequence a desired power output can be achieved for an acceptable level of stress and vibration. In the preferred

embodiment reaction wheel 11 and rotor 3 are balanced to also help eliminate stress and vibration at high rates of rotation.

Finally, Figure 6 shows yet a further embodiment of the present invention wherein a single engine block has a rotor with first and second vanes members, 33 and 34 respectively. In this instance a pair of reaction wheels positioned 180 degrees apart are also utilized. Each reaction wheel preferably contains two identical slots 16 situated diametrically opposed upon the reaction wheel such that they are separated rotationally by 180 degrees. It will therefore be understood that synchronization of the reaction wheels with the rotor will allow proper alignment of slots 16 with the cross-sectional area of cylinder bore 7 so as to permit each of the two vane members 8 to sweep past the respective reaction wheels. However, it will also be understood that rather than utilizing two separate slots within the reaction wheels, the rate of rotation of each reaction wheel could be set so that a single slot is aligned with the cross-sectional area of cylinder bore 7 at the appropriate time to allow for free revolution of both vane members.

Referring again specifically to Figure 6, both vane members 34 and 35 are shown in an initial position immediately after passing through the respective reaction wheels. At this point the reaction wheels are engaged with engine cylinder 6 such that they span cylinder bore 7 and define enclosed combustion and exhaust chambers. At the same time air input valve 24 is opened to allow filtered air to fill the engine cavity behind vane member 34 as it sweeps forward in a clockwise direction. Fuel input valve 23 is activated to inject a compressed fuel and air mixture into combustion chamber 14. Thereafter, the fuel input valve closes and the spark plug is fired to ignite the fuel and air mixture causing vane member 33, and rotor 3, to be propelled towards a first exhaust port 31. When first vane member 33 has proceeded past first exhaust port 31 burnt gases are allowed to escape from the combustion chamber and the pressure in the chamber drops. This effectively ends the power stroke and causes air input valve 24 to close. Thereafter both of the respective reaction wheels bring

their slots into alignment with the cross-sectional area of the cylinder bore so as to allow passage of first and second vane members 33 and 34 past the reaction wheels. At that point second vane member 34 will proceed into the initial position to commence its power stroke and the ignition process will be repeated. Any residual exhaust gases that may exist in front of first vane 33 will be driven from the cylinder bore outwardly through a second exhaust port 32.

It is to be understood that what has been described are the preferred embodiments of the invention and that it may be possible to make variations to these embodiments while staying within the broad scope of the invention. Some of these variations have been discussed while others will be readily apparent to those skilled in the art.

I CLAIM:

1. An internal combustion engine comprising:

an engine block having an engine cylinder with a circular and generally toroidal shaped bore with a relatively constant cross-sectional area;

a rotor rotationally positioned within said engine block and concentric with said engine cylinder, said rotor having at least one outwardly extending radial vane member having a leading and a trailing edge, said vane member received within said engine cylinder bore and dimensioned so as to closely fit within the internal cross-sectional area of said bore so that upon rotation of said rotor the walls of said engine cylinder bore are swept by said vane member; and,

at least one cylinder bore blocking means engageable and disengageable with said engine cylinder,

when said cylinder bore blocking means is engaged with said engine cylinder said cylinder bore blocking means spanning the internal cross-sectional area of said cylinder bore such that the portion of said cylinder bore between said cylinder bore blocking means and said trailing edge of said vane member defines a combustion chamber and the portion of said cylinder bore between said cylinder bore blocking means and said leading edge of said vane member defines an exhaust chamber, when said cylinder bore blocking means is disengaged from said engine cylinder said cylinder bore blocking means allowing for said vane member of said rotor to sweep past said cylinder bore blocking means within said cylinder bore.

2. A device as claimed in claim 1 wherein said cylinder bore blocking means when engaging said engine cylinder limiting the exchange of gases between said combustion and said exhaust chambers.

3. A device as claimed in claim 2 wherein said cylinder bore blocking means comprises a reaction wheel, said reaction wheel situated generally external to said engine block such that it rotationally engages and disengages said engine cylinder.

4. A device as claimed in claim 2 wherein said reaction wheel, when engaged with said engine cylinder, spanning the internal cross-sectional area of said cylinder bore generally parallel to the axis of rotation of said rotor.

5. A device as claimed in claim 4 wherein said reaction wheel includes at least one slot therethrough such that rotation of said reaction wheel causes said slot to selectively engage and disengage said engine cylinder, when said slot is engaged with said engine cylinder said reaction wheel remains exterior to said cylinder bore, said slot permitting said vane member of said rotor to sweep past said reaction wheel, when said slot in said reaction wheel is disengaged from said engine cylinder said reaction wheel spanning the internal cross-sectional area of said cylinder bore and, with said leading and said trailing edges of said vane member, defining said combustion and said exhaust chambers.

6. A device as claimed in claim 5 including timing means such that said reaction wheel and said rotor move in a synchronous fashion allowing said vane member of said rotor to sweep past said reaction wheel upon each revolution of said rotor.

7. A device as claimed in claim 6 wherein said engine cylinder includes fuel input means and exhaust means.

8. A device as claimed in claim 7 wherein said timing means is a synchronous gear drive.

9. A device as claimed in claim 1 wherein said rotor has a plurality of vane members.

10. A device as claimed in claim 1 including a plurality of cylinder bore blocking means.

11. A device as claimed in claim 1 wherein said internal combustion engine includes a plurality of engine blocks and rotors, each of said rotors adapted to transmit rotational energy to a common drive element.

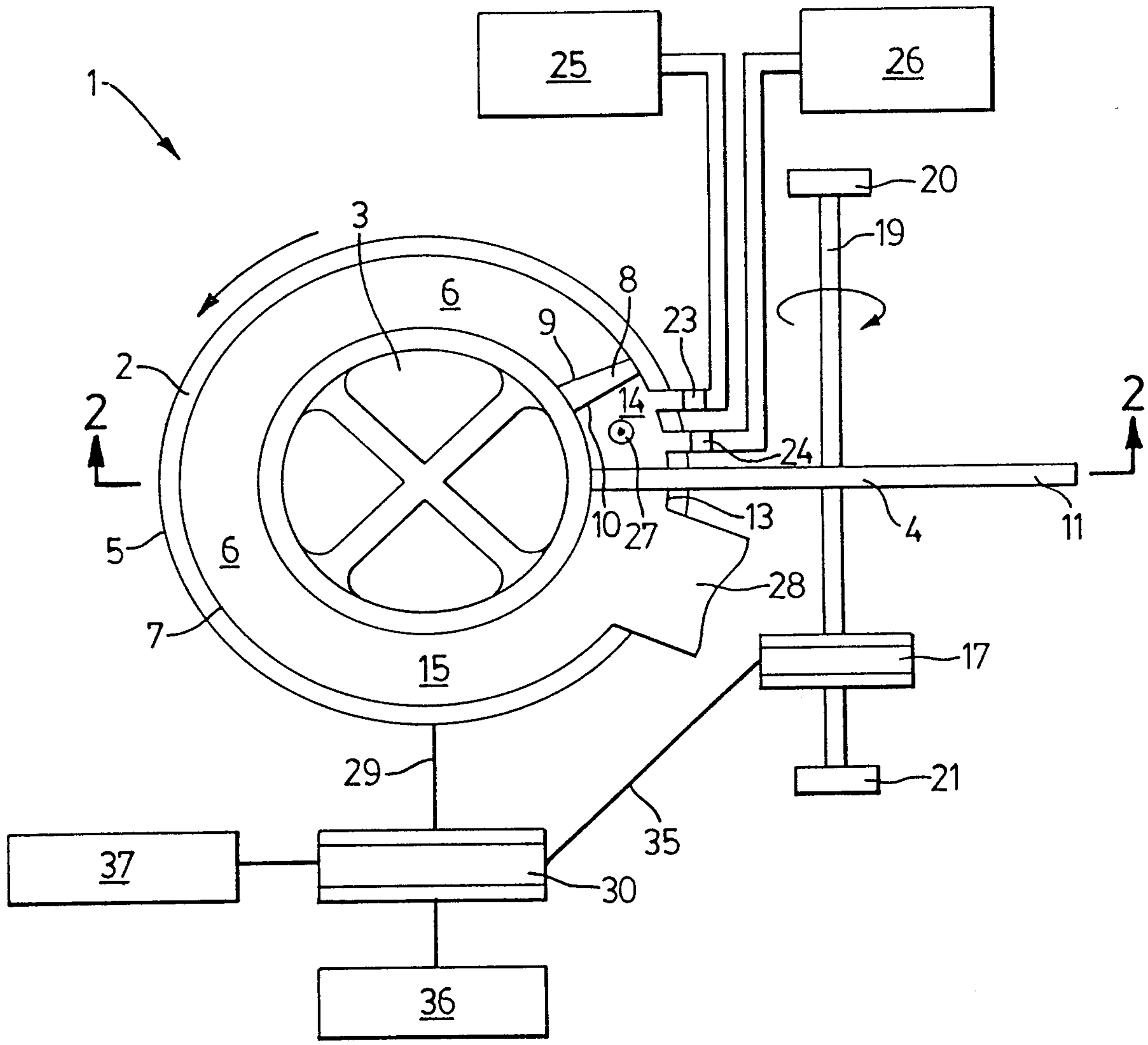
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FIG. 1

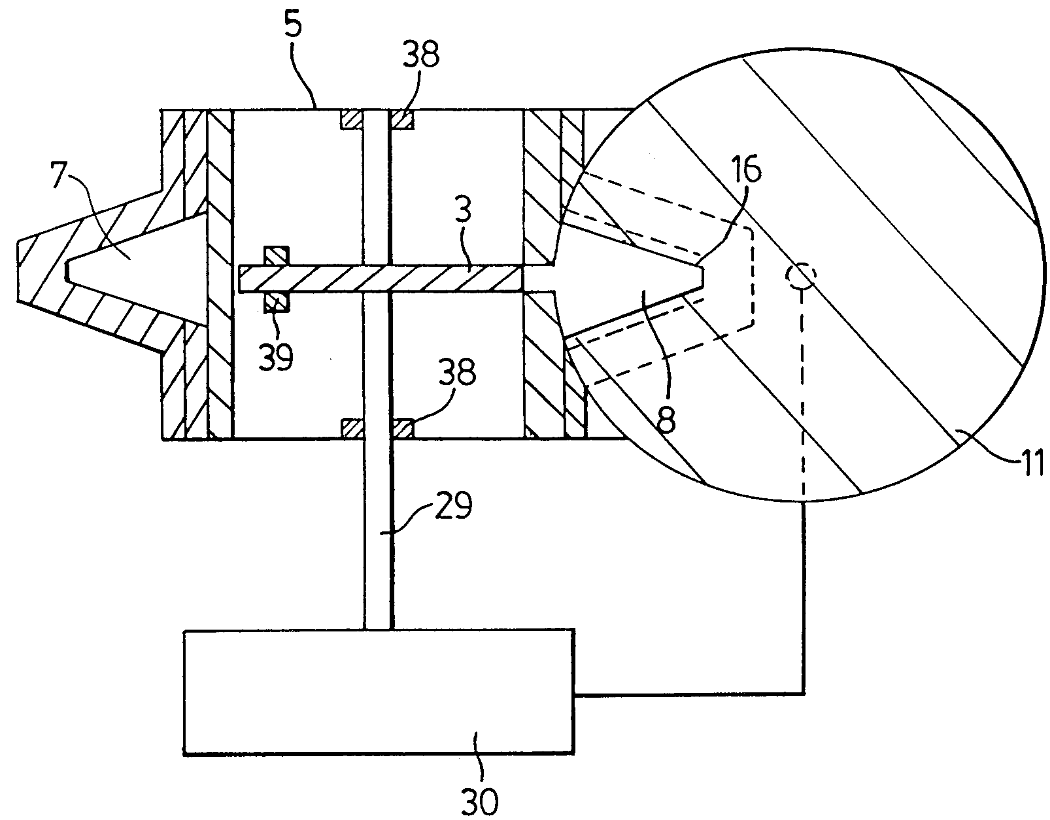

FIG. 2

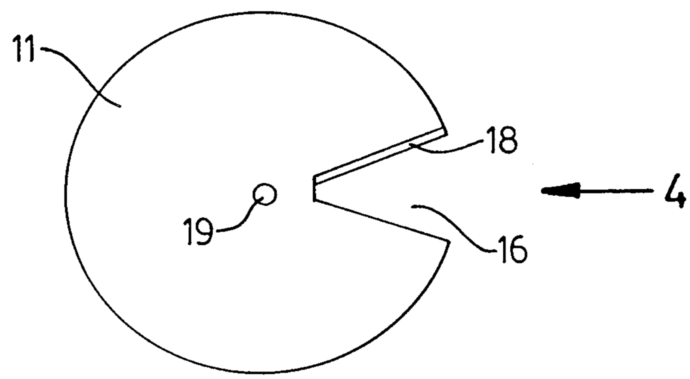

FIG. 3

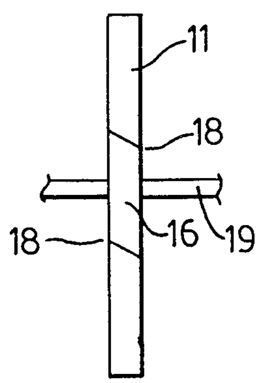

FIG. 4

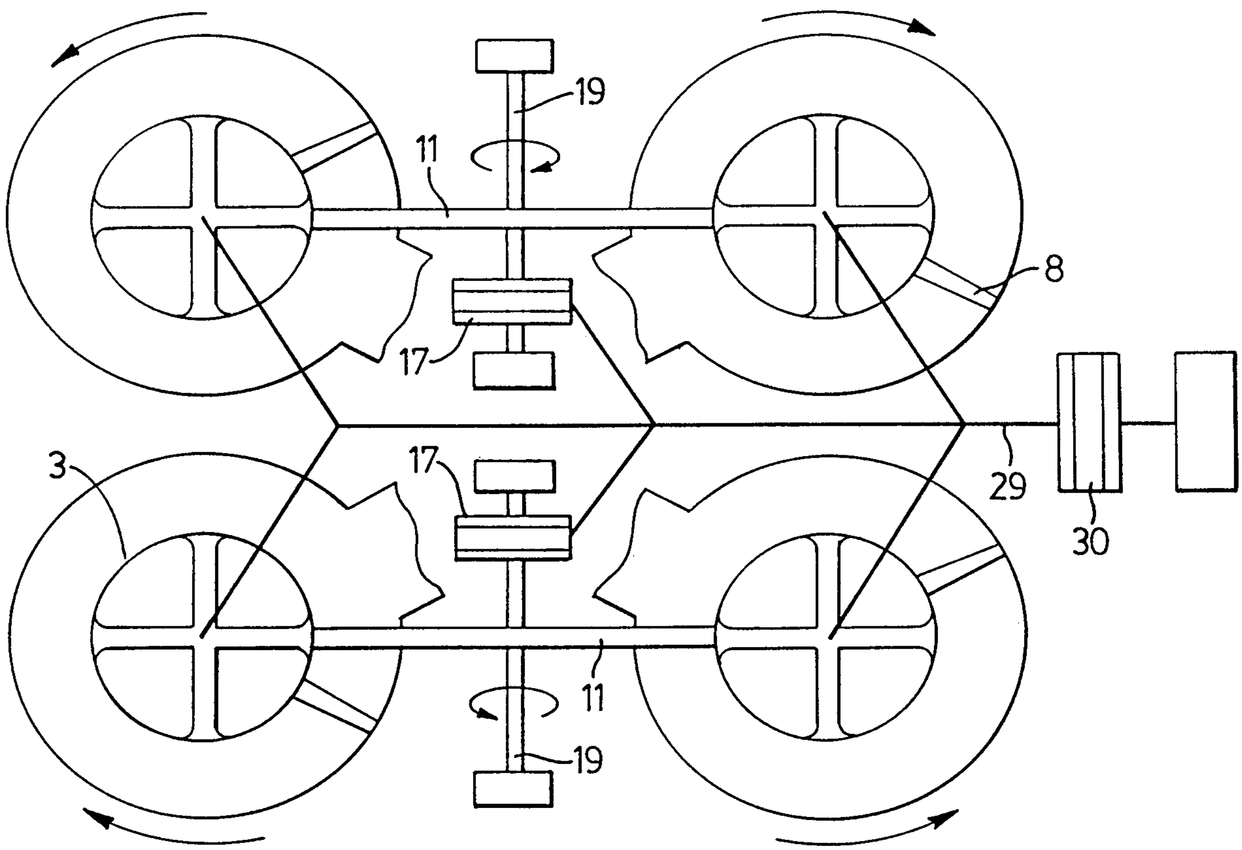

FIG. 5

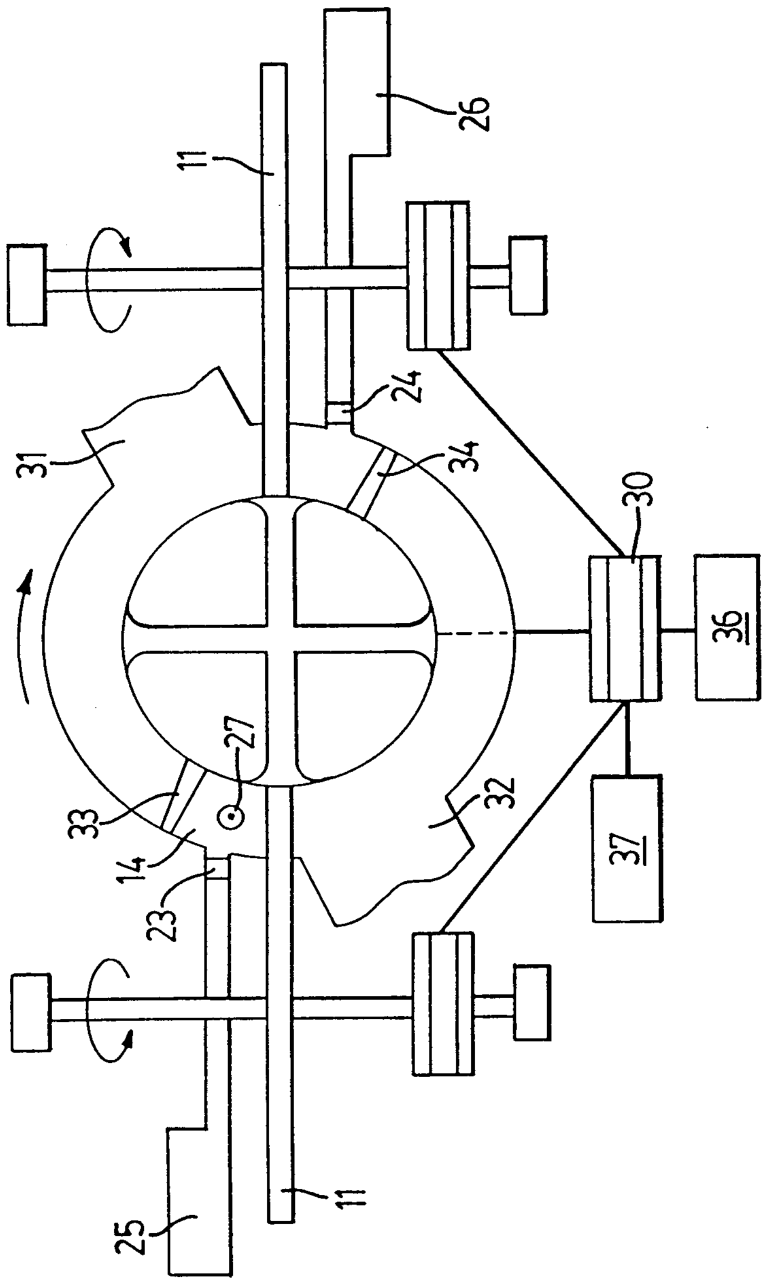

FIG. 6

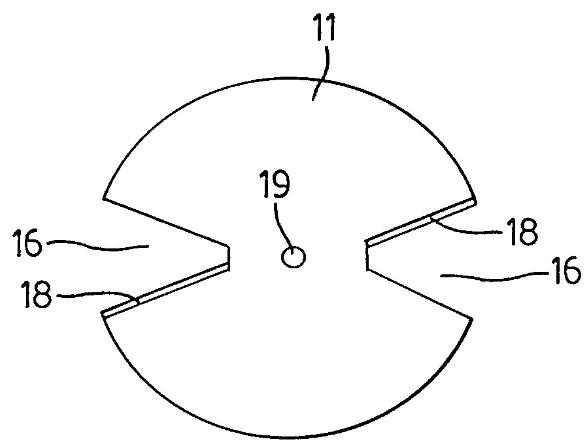

FIG. 7

INTERNATIONAL SEARCH REPORT

Inte. .ional Application No
PCT/CA 99/00713

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F01C3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F01C F04C F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 43519 A (BOUQUET HENRI) 20 November 1997 (1997-11-20) figures 1,2 abstract page 2, line 1 - line 29 ---	1-11
X	US 3 897 756 A (UPCHURCH LEWIS E) 5 August 1975 (1975-08-05) figures 1,2 abstract column 3, line 33 -column 4, line 49 ---	1-11
X	DE 43 00 410 A (KLEMM GERHARD WILHELM) 14 July 1994 (1994-07-14) figure 1 abstract ---	1-10
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 November 1999	08/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Wassenaar, G

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	DE 38 25 365 A (MYLAEUS ARMIN) 1 February 1990 (1990-02-01) figure 1 abstract	1-10

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. .ional Application No
PCT/CA 99/00713

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9743519	A	20-11-1997	FR	2748775 A	21-11-1997
			AU	1314297 A	05-12-1997
US 3897756	A	05-08-1975	NONE		
DE 4300410	A	14-07-1994	DE	4305342 A	22-09-1994
			DE	4319896 A	22-12-1994
DE 3825365	A	01-02-1990	NONE		

DERWENT-ACC-NO: 2000-270837

DERWENT-WEEK: 200031

TITLE: Rotary internal combustion engine comprises concentric rotor moving within one circular toroidal shaped cylinder and bore blocking means forming combustion and exhaust chambers

INVENTOR: ONDRICH M

PATENT-ASSIGNEE: ONDRICH M[ONDRI]

PRIORITY-DATA: 1998US-140731 (August 27, 1998)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
WO 0012867 A1	March 9, 2000	EN
AU 9951438 A	March 21, 2000	EN

DESIGNATED-STATES: AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CU CZ DE DK EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT UA UG UZ V N YU ZA ZW AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW NL OA PT SD SE SL SZ UG ZW

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
WO2000012867A1	N/A	1999WO-CA00713	August 5, 1999
AU 9951438A	Based on	1999AU-051438	August 5, 1999

INT-CL-CURRENT:

TYPE	IPC DATE
CIPS	F01C3/02 20060101

ABSTRACTED-PUB-NO: WO 0012867 A1

BASIC-ABSTRACT:

NOVELTY - An internal combustion engine (1) has an engine block (2) containing a circular engine cylinder (6) with a constant generally toroidal shaped bore (7). A rotor (3) is concentrically mounted within the cylinder and has at least one radially extending vane (8) with leading (9) and trailing (10) edges. The vane is a precise fit in said bore to separate the bore into two chambers.

DESCRIPTION - A cylinder bore blocking means (4) in the form of a slotted rotary reaction wheel (11) can engage the cylinder bore to form separate combustion (14) and exhaust (15) chambers with the radial vane. As it rotates, the wheel disengages from the bore to allow free passage of vane through this section of the cylinder.

USE - For use as rotary internal combustion engine with a circular toroidal shaped cylinder.

ADVANTAGE - The rotary engine is mechanically simpler and more fuel-efficient.

DESCRIPTION OF DRAWING(S) - The drawing shows a schematic view of the engine.

Engine (1)

Engine block (2)

Rotor (3)

Cylinder bore blocking means (4)

Engine cylinder (6)

Cylinder bore (7)

Radial vane (8)

Leading and trailing edges (9,10)

Rotating reaction wheel (11)

Engine bore slot (13)

Combustion chamber (14)

Exhaust chamber (15)

CHOSEN-DRAWING: Dwg.1/7

TITLE-TERMS: ROTATING INTERNAL COMBUST ENGINE COMPRISE CONCENTRIC ROTOR MOVE ONE CIRCULAR TOROIDAL SHAPE CYLINDER BORE BLOCK FORMING EXHAUST CHAMBER

DERWENT-CLASS: Q51

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: 2000-202869